

## CLAIMS

### I claim:

1. A water treatment apparatus, comprising:
  - a) at least one water treatment tank defining a fluid flow path between a tank inlet and a tank outlet, and including a compartment containing a water treatment material through which water to be treated is passed;
  - b) a control device in fluid communication with said tank inlet and said tank outlet for controlling fluid flow along said tank fluid flow path and for controlling the regeneration of said water treatment material in said tank compartment, said control device including:
    - i) a housing;
    - ii) a pair of venturi chambers defined by said housing, one of said chambers operative to provide a co-current regeneration of said material and the other of said venturi chambers operative to provide a countercurrent regeneration of said media;
    - iii) a fluid pressure operated inlet valve for controlling the communication of a source of water to be treated with said tank inlet;
    - iv) a fluid pressure operated outlet valve for controlling the communication of said tank outlet with a discharge conduit;
    - v) a fluid pressure operated drain valve for controlling the fluid communication between said tank inlet and an ambient drain;
    - vi) a fluid pressure operated purge valve for controlling the fluid communication of said tank outlet with said ambient drain; and,
    - vii) a fluid pressure operated regeneration initiation control valve for providing a fluid signal, under predetermined operating conditions, to a remote control device for initiating regeneration in a tank associated with said remote control device.

2. The apparatus of claim 1, wherein said control device includes:  
a) an inlet chamber in communication with said source of water to be treated;  
b) a transfer chamber in selective communication with said inlet chamber;  
and,  
c) said inlet valve controlling the communication of water in said inlet chamber with said tank inlet and further including structure for controlling communication between said inlet chamber and said transfer chamber.

3. The apparatus of claim 2, wherein said inlet valve includes a first seat for controlling the communication between said inlet chamber and said tank inlet and a second seat for controlling the fluid communication between said inlet chamber and said transfer chamber.

4. The apparatus of claim 1, wherein said control device includes a regeneration turbine operatively coupled to a fluid signal control system, said control system operative to provide fluid signals to said inlet valve, said outlet valve, said drain valve, said purge valve and said regeneration initiation control valve in a predetermined sequence, said regeneration turbine in fluid communication with a regeneration initiation port forming part of said valve, such that a regeneration sequence can be initiated upon application of a fluid signal to said regeneration initiation port.

5. The apparatus of claim 1, wherein said drain and purge valves communicate with said ambient drain via a flow control element which controls the rate of flow of fluid from said purge and drain valves to said drain.

6. The apparatus of claim 1, wherein at least one of said venturi chambers includes a replaceable venturi element, the throat of which communicates with a source of regeneration fluid.

7. The apparatus of claim 6, wherein said venturi chamber includes an access cover by which access to said venturi element is obtained.

8. The apparatus of claim 7, wherein said throat of said venturi element communicates with a source of regeneration fluid via a port forming part of said housing.

9. The apparatus of claim 8, wherein said housing defines an external port communicating with said regeneration initiation control valve, said port connectable to said remote control device.

10. A control valve assembly for controlling the communication of water to and from a treatment tank and for controlling the regeneration of a treatment material contained by a tank, comprising:

- a) a control valve housing defining structure for connecting said control valve to a tank inlet and a tank outlet;
- b) an inlet chamber and an outlet chamber defined by said housing, said inlet chamber communicating with a source of water to be treated and said outlet chamber communicating with an outlet port forming part of said control valve;
- c) a fluid pressure operated inlet valve for controlling the communication of said inlet chamber with said tank inlet;
- d) an outlet valve for controlling the fluid communication between said tank outlet and said outlet chamber;
- e) a pair of venturi chambers, one of said chambers being adaptable to provide co-current regeneration of said treatment tank and the other of said venturi chambers adaptable to provide countercurrent regeneration of said treatment tank; and,
- f) at least one of said venturi chambers including a removable access

member by which a venturi element within the chamber can be accessed without requiring further disassembly of said control valve.

11. The control valve assembly of claim 10, wherein said other of said venturi chambers also includes a removable access member by which a venturi element within the other chamber can be accessed without requiring further disassembly of said control valve.

12. The control valve assembly of claim 10, further including a first regeneration control valve operative, under predetermined operating conditions, to communicate water in said outlet chamber to a remote control valve assembly associated with a remote treatment tank in order to initiate regeneration of said remote tank.

13. The control valve assembly of claim 10, further including a servo control system operative to provide fluid signals to fluid pressure operated valves in said control valve assembly in a predetermined sequence and a regeneration control turbine for driving a control disc forming part of said servo control system, said housing defining a fluid flow path for directing water in an impinging relationship with said turbine, said fluid path communicating with a fluid source external to said control valve assembly whereby regeneration of said treatment tank is initiated.

14. The control valve assembly of claim 10, further including a fluid pressure operated drain valve for controlling the communication of said tank inlet with an ambient drain and a fluid pressure operated purge valve for controlling the communication of said tank outlet with said ambient drain.

15. The control valve of assembly claim 10, further including a regeneration control valve for controlling the communication of water in said

outlet chamber with said regeneration turbine, said regeneration control valve operative to convey water from said outlet to said regeneration turbine in order to rotate said turbine under predetermined operating conditions.

16. The control valve assembly of claim 10, further including a bypass chamber in fluid communication with said outlet chamber, said inlet valve controlling the fluid communication between said inlet chamber and said bypass chamber, such that under predetermined operating conditions, said inlet valve allows water in said inlet chamber to travel directly to said outlet chamber via said bypass chamber without passing through said treatment tank.

17. The control valve assembly of claim 11, wherein said venturi element in said co-current venturi chamber establishes a communication between said inlet chamber and said tank inlet and a throat of said venturi element communicates with a source of regeneration fluid.

18. The control valve assembly of claim 11, wherein said venturi element in said countercurrent venturi chamber establishes a fluid communication between said tank outlet and said outlet chamber and a throat of said venturi element communicates with a source of regeneration fluid.

19. A water treatment apparatus, comprising:

a) at least one water treatment tank defining a fluid flow path between a tank inlet and a tank outlet, and including a compartment containing a water treatment material through which water to be treated is passed;

b) a control device in fluid communication with said tank inlet and said tank outlet for controlling fluid flow along said tank fluid flow path and for controlling the regeneration of said water treatment material in said tank compartment, said control device including:

i) a housing;

- ii) a regeneration control turbine forming part of a regeneration control subsystem;
- iii) a nozzle for directing fluid into an impinging relationship with said turbine for producing rotation in said turbine; and,
- iv) structure in said housing defining a passage communicating said nozzle with an external port on said housing, said port adapted to receive fluid from a source external to said valve in order to provide a driving force for said turbine.

20. The treatment system of claim 19, wherein said control device includes a fluid pressure operated control valve which is selectively opened in order to provide fluid to said passage from a source within said housing whereby a sustaining fluid flow to said regeneration turbine is provided.

21. The treatment system of claim 20, wherein said control device further includes a fluid pressure operated initiation control valve which is selectively operated to communicate a source of fluid pressure within said control device to an external port on said housing, said port connectable to a remote control device whereby regeneration in said remote control device can be initiated by selectively operating said initiation control valve.

22. The treatment system of claim 19, wherein said housing includes an external drain port and a flow controller in said drain port that is accessible via said drain port.

23. A control valve assembly for controlling the communication of water to and from a treatment tank and for controlling the regeneration of a treatment material contained by the treatment tank, comprising:

- a) a housing defining structure for connecting said control valve assembly to a tank inlet and a tank outlet;

- b) an inlet chamber and an outlet chamber defined by said housing, said inlet chamber communicating with a source of water to be treated and said outlet chamber communicating with an outlet of said control valve assembly;
- c) a bypass chamber defined by said housing in fluid communication with said outlet chamber;
- d) a fluid pressure operated inlet valve for controlling the communication of said inlet chamber with said tank inlet, and controlling the communication of said inlet chamber with said bypass chamber;
- e) said fluid pressure operated inlet valve having first and second seating surfaces associated with first and second seats;
- f) said first seating surface engageable with said first seat, such that communication of said inlet chamber with said tank inlet is inhibited while communication between said inlet chamber and said transfer chamber is enabled; and,
- g) said second seating surface being engageable with said second seat whereby communication between said inlet chamber and said transfer chamber is inhibited while enabling communication between said inlet chamber and said tank inlet.

24. The control valve assembly of claim 23, wherein said first and second seating surfaces are formed on a valve element forming part of said inlet valve, using an over molding process.

25. The control valve assembly of claim 24, wherein said transfer chamber is adapted to receive a blocking wall whereby communication between said transfer chamber and said outlet chamber is inhibited.